

Abstract

Observable changes in electrical and optical characteristics of individual molecules adsorbed on a conductor or semi-conductor caused by electrical and/or optical excitation or de-excitation of electrons within such molecules can be used as signals which in turn can be used to carry information and such observable information carrying changes or signals can be switched, amplified, and modulated by varying optical as well as electrical inputs to such molecules. Molecular structural design alters functional behavior of the molecular/quantum devices. In an example, monomeric metallated phthalocyanine behaves as a fast ($< 10^{-12}$ second), energy efficient (30kT/bit of information), fully reversible quantum switch with multiple outputs. However, if monomeric phthalocyanines are organized in structural combinations such as one dimensional wire-like ring-stacked, or two dimensional sheet-like ring-fused phthalocyanines, their electro-optical properties are significantly altered. As a consequence, their functionality behaves with properties that can replace a multiplicity of CMOS and similar classic semiconductor devices.

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